



March 15, 2013

Mr. David Smith, Manager
NPDES Permits Office, WTR-5
USEPA, Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

RE: New Product Testing Approval For Anodamine as Substitute For Hydrazine

Dear Mr. Smith:

Arizona Public Service Company, Four Corners Power Plant would like to use a new chemical, Anodamine, in its Units 1-2-3 boilers as an oxygen scavenger for potential replacement of hydrazine in the future at other boilers in our company. The chemical is called Anodamine and is a HPFG propriety blend. An MSDS and Aquatic Testing results are included for your review. Additionally, a technical paper is enclosed that provides the benefits and recommendations of APS engineering staff.

The chemical would be used until the Units 1-2-3 are shut down, probably July 1, 2013, that is if you provide permission. The chemical is suppose to be more effective and less hazardous to the environment. We would like to trial it in the units to obtain success on a short term basis.

We would appreciate your quick review and approval for this new, potentially less hazardous chemical use as an oxygen scavenger in our boilers. Thank you for your consideration.

Sincerely,


David C. Bloomfield
Four Corners Site Manager

Enclosures



MATERIAL SAFETY DATA SHEET

Manufactured exclusively in the USA using
locally manufactured and supplied raw materials

Date Issued: 6/6/2012

Revised: 6 June 2012

MSDS Ref.

No: MSDS-USA-06-12-HPFG+

Revision No: 19 New MSDS original.

1. PRODUCT AND COMPANY IDENTIFICATION

GENERAL USE: High Pressure Boiler Metal Passivation Scale and Corrosion Inhibition.

PRODUCT DESCRIPTION: Proprietary non-toxic mixture of surface-active polyamines.

PRODUCT CODE: anodamine™ HPFG+ proprietary blend.

PRODUCT FORMULATION NAME: anodamine™ HPFG+

CHEMICAL FAMILY: Surface active amines.

MOLECULAR FORMULA: Proprietary

2. COMPOSITION / INFORMATION OF INGREDIENTS

Chemical Name

Typical CAS components (unknown)

Wt. % CAS # EINECS #

Proprietary Non Toxic Components

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

PHYSICAL APPEARANCE: Clear to colorless organic liquid with limited odor.

IMMEDIATE CONCERNS: None.

POTENTIAL HEALTH EFFECTS

EYES: Expected to cause mild irritation to the eyes with exposed contact.

SKIN: May cause mild irritation to the skin of some.

SKIN ABSORPTION: None Expected.

INGESTION: May cause mild irritation to the digestive tract if ingested in large quantities.

INHALATION: No irritation to the lungs, upper respiratory tract and nose with extended exposure.

ACUTE TOXICITY: No test data is available for acute dermal toxicity.

Not expected to cause significant adverse effects if ingested in large quantities.

No test data is available for acute inhalation toxicity.

4. FIRST AID MEASURES

EYES: Immediately flush eyes with plenty of water for two to three minutes. Remove any contact lenses and continue flushing for 15 minutes. Get medical attention.

SKIN: Remove contaminated clothing including shoes and immediately wash affected area with plenty of soap and water. Wash contaminated clothing and shoes before reuse.

INGESTION: Wash out mouth with water and keep at rest. Seek medical attention.

INHALATION: No affects or symptoms are expected when handling the product when displaying good chemical house keeping and use of PPE.

ADDITIONAL INFORMATION: None.

COMMENTS: None.

5. FIRE FIGHTING MEASURES

FLASHPOINT AND METHOD: ~ 250°C None Expected.

FLAMMABLE LIMITS: Non flammable.

AUTOIGNITION TEMPERATURE: ~ 600°C

6. ACCIDENTAL RELEASE MEASURES

SMALL SPILL: Construct temporary dikes of dirt, sand, or any appropriate readily available material to prevent spreading of the material.

Wearing the appropriate personal protective equipment designated in Section 8, close or cap valves and/or block or plughole in leaking container and transfer to another container.

Sweep up spilled material and disperse of at appropriate waste disposal facility according to current applicable laws and regulations. Flush area with water and ensure that the contaminated water is handled according to applicable laws.

LARGE SPILL: Not yet known

ENVIRONMENTAL PRECAUTIONS

WATER SPILL:

This material will not cause adverse environmental impact if it reaches waterways. The material is considered as NON-HAZARDOUS to the aquatic environment.

LAND SPILL: None

AIR SPILL: None known.

GENERAL PROCEDURES: Shovel up and dispose of at an appropriate waste disposal facility according to current applicable laws and regulations, and product characteristics at time of disposal.

RELEASE NOTES:

This material will not cause adverse environmental impact if it reaches waterways. The material is considered as NON-HAZARDOUS to the aquatic environment.

In case of accident or road spill notify: CHEMTREC in USA at 800-424-9300 CANUTEC in Canada at 613-996-6666 CHEMTREC, other countries, at (International code) +1 703 527 3887

SPECIAL PROTECTIVE EQUIPMENT: CHEMTREC in USA at 800-424-9300 CANUTEC in Canada at 613-996-6666 CHEMTREC, other countries, at (International code) +1 703 527 3887

COMMENTS: See Section 13 for disposal information and Section 15 for regulatory requirements. Large and small spills may have a broad definition depending on the user's handling system. Therefore technically qualified personnel must define the spill category at the point of release.

7. HANDLING AND STORAGE

GENERAL PROCEDURES: Do to limitations of packaging, do not store at temperatures above 180°F as the product container may degrade and may result in release.

HANDLING: Use appropriate personal protective equipment as specified in Section 8. Handle and use in a manner consistent with good industrial/manufacturing techniques and responsible chemical handling practices.

STORAGE: Store in unopened containers under cool and dry conditions.

STORAGE TEMPERATURE: Ambient conditions. Avoid extended exposure to direct sun with open containers.

LOADING TEMPERATURE: NA = Not Applicable

8. EXPOSURE CONTROLS / PERSONAL PROTECTION**EXPOSURE GUIDELINES:****OSHA HAZARDOUS COMPONENTS (29 CFR 1910.1200)**

Toxicological results for bioassays on corrosion inhibitor **amodamine HPFG food grade.**

The	<i>Investigative Species</i>	<i>Observations</i>
		LC50
	Daphnia Pulex 48 hour	89,531.36 ppm 95 % Lower Confidence Limit: 86,079.85 ppm 95 % Upper Confidence Limit: 93,121.27 ppm
	Pimephales Promelas 96 hour	49,210.46 ppm 95 % Lower Confidence Limit: 55,755.86 ppm 95 % Upper Confidence Limit: 43,433.46 ppm

Environmental Protection Agency's Trimmed Spearman-Kärber statistical program was used to analyze all data.

The 48-Hour LC-50 (concentration at which 50% mortality is expected to occur) for amodamine™ HPFG, Daphnia pulex survival data, was calculated by the Spearman- Karber program, as 89,531.36 ppm.

The 96-Hour LC-50 (concentration at which 50% mortality is expected to occur) for amodamine™ HPFG, Pimephales promelas survival data, was calculated by the Spearman-Karber program, as 49,210.46 ppm.

Both the lethal and sub-lethal endpoints were statistically calculated according to their respective EPA guidelines. The Chronic Freshwater organisms were calculated according to EPA-821-R-02-013, October 2002 Fourth Edition. The Chronic Marine and Estuarine organisms were calculated according to EPA-821-R-02-014, October 2002 Third Edition. The Acute Freshwater and Marine organisms were calculated according to EPA-821-R-02-012, October 2002 Fifth Edition.

ENGINEERING CONTROLS: Normal ventilation is normally required when handling or using this material.

PERSONAL PROTECTIVE EQUIPMENT**EYES AND FACE:**

Wear safety glasses with side shields or goggles when handling this material.

SKIN:

Wear protective chemically resistant gloves.

RESPIATORY:

No special precautions are necessary under normal operating conditions and with adequate ventilation.

PROTECTIVE CLOTHING:

None

WORK HYGIENIC PRACTICES:

Good Personal hygiene practices should always be followed.

OTHER USE PRECAUTIONS: None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: Liquid
ODOR: Very slight smell of ammonia
APPEARANCE: Clear liquid, depending on age/concentration slight straw color.
COLOR: Colorless
pH: ~ 6.0
PERCENT VOLATILE: ~ 50% at > 250°C
BOILING POINT: similar to water
SPECIFIC GRAVITY: 0.98

10. STABILITY AND REACTIVITY

STABLE: YES
HAZARDOUS POLYMERIZATION: NO
CONDITIONS TO AVOID: None
STABILITY: The product is stable under normal ambient conditions of temperature and pressure.
POLYMERIZATION: None
HAZARDOUS DECOMPOSITION PRODUCTS: At temperatures above 550°C decomposition products can include acetaldehydes and in the presence of oxygen, small concentrations of carbon dioxide (traces) are liberated.
INCOMPATIBLE MATERIALS: Strong Acids.
COMMENTS: None Expected

11. TOXICOLOGICAL INFORMATION

ACUTE

DERMAL LD₅₀: ~ 90,000 Dermal LD50 (rabbit) = 90,000 mg/kg

EYE EFFECTS: This material is not expected to cause significant irritation to the eyes.

SKIN EFFECTS: This material is not expected to cause significant irritation to the skin.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL DATA: This material will not cause adverse environmental impact if it reaches waterways. The material is considered as NON-HAZARDOUS to the aquatic environment.

ECOTOXICOLOGICAL INFORMATION:

Acute toxicity test in *Daphnia sp.* (OECD 202, 2004)

It was established, Environmental Protection Agency's Trimmed Spearman-Kärber statistical program was used to analyze all data. The 48-Hour LC-50 (concentration at which 50% mortality is expected to occur) for *ammonia*™ HPFG, *Daphnia pulex* survival data, was calculated by the Spearman-Kärber program, as 89,531.36 ppm. The 96-Hour LC-50 (concentration at which 50% mortality is expected to occur) for *ammonia*™ HPFG, *Pimephales promelas* survival data, was calculated by the Spearman-Kärber program,

as 49,210.46 ppm, for the corrosion inhibitor sample **ammonium HPFG** food grade was well above 100 mg/L, therefore the sample is classified as **NON-HAZARDOUS** to the aquatic environment.

Other information:

Biological Degradability: >554% (BSB₁₂/CSB*100), product may be slightly retained by silicate containing soil.

Class of Water Endangerment: 1 (self classification): slight danger to water

DISTRIBUTION: The material is readily biodegradable based on a 28-day study with oxygen depletion of at least 90% of the theoretical maxima.

CHEMICAL FATE INFORMATION: Class of Water Endangerment: 1 (self classification): slight danger to water.

COMMENTS: Information based upon data for an equivalent product and analog.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: Dispose of waste at an appropriate waste disposal facility according to current applicable laws and regulations.

FOR LARGE SPILLS: This material will not cause adverse environmental impact if it reaches waterways.

PRODUCT DISPOSAL: Collect in appropriate containers. Dispose of at an appropriate waste disposal facility in accordance with current applicable laws and regulation, and product characteristics at time of disposal.

EMPTY CONTAINER: Triple rinse (or equivalent) all containers and offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill or other procedures approved by state and local authorities.

RCRA/EPA WASTE INFORMATION: NA

RCRA HAZARD CLASS: None Expected

14. TRANSPORTATION INFORMATION

DOT (DEPARTMENT OF TRANSPORTATION)

TECHNICAL NAME:

PRIMARY HAZARD CLASS/DIVISION:

LABEL:

MARINE POLLUTANT #1:

MARINE POLLUTANT #2:

OTHER SHIPPING INFORMATION:

Road Transport ADR/RID and GGVS/GGVE:

Sea Transport IMDG/GGVSee:

Air Transport ICAO-TI and IATA-DGR:

Proprietary Formulation.

Non-Hazardous Material.

N/A

None Expected

No Data Available Contact Env. Dept.

Not a regulated material.

Non-dangerous goods

Non-dangerous goods

Non-dangerous goods

15. REGULATORY INFORMATION

UNITED STATES SARA TITLE III

(SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

311/312 HAZARD CATEGORIES:

NA

FIRE: NO

PRESSURE GENERATING:

NO

REACTIVITY: NO

ACUTE: NO

CHRONIC:

NO

313 REPORTABLE INGREDIENTS:	NA
TITLE III NOTES:	NOT YET DETERMINED
CERCLA (COMPREHENSIVE RESPONSE, COMPENSATION, AND LIABILITY ACT)	
CERCLA REGULATORY:	NOT YET DETERMINED
EPA	
EPA RQ INGREDIENT:	NONE EXPECTED
EPA RQ PRODUCT:	NONE KNOWN
TSCA (TOXIC SUBSTANCE CONTROL ACT)	
TSCA REGULATORY:	NA
TSCA STATUS:	NA

16. OTHER INFORMATION:

PREPARED BY: Paul R. Hattingh

INFORMATION CONTACT: Product Stewardship Analyst.

MANUFACTURER DISCLAIMER: Information given herein is offered in good faith as accurate, but without guarantee. Conditions of use and suitability of the product for particular uses are beyond our control; all risks of use of the product are therefore assumed by the user. Nothing is intended as a recommendation for uses which infringe valid patents or as extending license under valid patents. Appropriate warnings and safe handling procedures should be provided to handlers and users.



ADDITIONAL MSDS INFORMATION: The information given is based on the present state of knowledge and experience according to the law on declaration and preparation of dangerous chemicals as well

as on toxicological investigations for self-classification in the class of water endangerment according to the concept of self-classification of preparations.

GENERAL STATEMENTS: This product and its handling should attract sensible and good housekeeping practice, the use of PPE typical for handling of any chemicals.

Made in America

All anodamine™ proprietary metal surface-active protection products are exclusively manufactured in the USA using locally sourced raw materials.

Sole manufacture and distribution by anodamine™ Inc

2590 Oakmont Drive

Suite 310/320

Round Rock Texas, 78665

Tel: + 1 (512) 244 2318

www.anodamine.com



Bio-Aquatic Testing, Inc.



Anodamine

48 Hr and 96 Hr Acute Biomonitoring Report

48068

Daphnia pulex
Pimephales promelas

March 07, 2011

Approved by: *Chris Robason*
Chris Robason,
President

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Unless otherwise noted in the body of the report, all data reported in this document are in compliance with NELAC standards and apply only to the samples referenced within. This report document may not be edited or reproduced in part or in full by any other entity, unless Bio-Aquatic Testing, Inc. issues written approval.

***HAND-WRITTEN RAW DATA TABLES ARE AVAILABLE UPON REQUEST**

BIO-AQUATIC TESTING, INC.

2501 Mayes Road, Suite 100

Carrollton, Texas 75006

Tel: (972) 242-7750

Fax: (972) 242-7749

TOXICITY TEST REPORT - 48 Hr Acute

Client:	Anodamine	Sample:	product
Facility:		Laboratory Number:	48068
Permit No.		Date:	March 07, 2011

Daphnia pulex had an LC50 of 89,531.36 ppm and *Pimephales promelas* had an LC50 of 49,210.46 ppm.

SAMPLE PREPERATION: Exploratory tests were conducted on the Anodamine product to determine a final definitive test dilution series. Product dilutions and laboratory dilution water pH, temperature, and dissolved oxygen data were collected at test initiation, after 48 hours, and at test completion.

TEST PROCEDURES:

Daphnia pulex

EPA METHOD: 2021

The 48 Hr Acute *Daphnia pulex* test was initiated at 17:25 hours on March 07, 2011. Eight effluent concentrations of 10,000 ppm, 50,000 ppm, 60,000 ppm, 75,000 ppm, 85,000 ppm, 100,000 ppm, 150,000 ppm, and 200,000 ppm were prepared utilizing synthetic water. The test was set up with 30mL plastic cups containing 15mL of test solution. Each concentration or control consisted of five replicate cups with eight organisms each, giving a total of 40 (forty) per treatment. The control was conducted concurrently with the test. Test organisms were less than 24-hour old laboratory cultured neonates. Organisms were introduced into the test solutions using a blocking design. Food consisting of a ten-microliter suspension of the green algae, *Selenastrum capricornutum*, YTC and cerophyll was added to the test solutions each day as food. The test proceeded for 48 hours. Data on survival was collected daily and water quality parameters were recorded after each 48-hour period. The test was static non-renewal. The test ended at 17:00 hours on March 09, 2011. Survival data was statistically ($p=0.05$) analyzed according to EPA procedures to determine the LC50.

SURVIVAL:

Daphnia pulex

The Environmental Protection Agency's Trimmed Spearman-Kärber statistical program was used to analyze all data.

The 48-Hour LC-50 (concentration at which 50% mortality is expected to occur) for Anodamine, *Daphnia pulex* survival data, was calculated by the Spearman-Kärber program, as 89,531.36 ppm.

LC₅₀: 89,531.36 ppm

95% Lower Confidence Limit: 86,079.85 ppm

95% Upper Confidence Limit: 93,121.27 ppm

TEST PROCEDURES:

Pimephales promelas

EPA METHOD: 2000

The 96 Hr Acute *Pimephales promelas* test was initiated at 17:00 hours on March 07, 2011. Eight effluent concentrations of 10,000 ppm, 50,000 ppm, 60,000 ppm, 75,000 ppm, 85,000 ppm, 100,000 ppm, 150,000 ppm, and 200,000 ppm were prepared utilizing synthetic water. The test was set up with 450mL plastic cups containing 250mL of test solution as test chambers. Each concentration or control consisted of five replicate chambers containing eight organisms each, giving a total of 40 (forty) per treatment. The control was conducted concurrently with the test. Test organisms were laboratory cultured *P. promelas* one to fourteen days old, and all larvae used in each test are hatched within 24 hours of each other. The number of surviving larvae and water quality parameters were recorded after each 24 hour period. The test was renewed after 48 hours with fresh solutions. Surviving larvae in each test chamber were fed freshly hatched brine shrimp two times per day. The test proceeded for 96 hours. The test ended at 08:10 hours on March 11, 2011. Survival was statistically ($p=0.05$) analyzed according to EPA procedures to determine the LC50.

SURVIVAL:

Pimephales promelas

The Environmental Protection Agency's Trimmed Spearman-Kärber statistical program was used to analyze all data.

The 96-Hour LC-50 (concentration at which 50% mortality is expected to occur) for Anodamine, *Pimephales promelas* survival data, was calculated by the Spearman-Kärber program, as 49,210.46 ppm.

LC₅₀: 49,210.46 ppm

95% Lower Confidence Limit: 55,755.86 ppm

95% Upper Confidence Limit: 43,433.46 ppm

BIO-AQUATIC TESTING, INC.
TOXICITY TEST

48 Hr Acute *Daphnia pulex*

Client: <u>Anodamine</u>	Lab ID: 48068	
Permit Number:	Test Temperature (oC): 25 ± 1	
Sample Type:	Photo Period: 16 hours light 8 hours dark	
Receiving Water Name:	Begin Date: 3/7/2011	
	End Date: 3/9/2011	

Test Start Time: 17:25 Test End Time: 17:00

SURVIVAL

Effluent Con. ppm	SURVIVAL															Avg% Surv.
	Number Of Alive Per Replicate															
	3/7					3/8					3/9					
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	
Synthetic Control	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	100.0%
10,000	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	100.0%
50,000	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	100.0%
60,000	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	100.0%
75,000	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	100.0%
85,000	8	8	8	8	8	7	6	5	6	8	5	4	4	5	2	50.0%
100,000	8	8	8	8	8	6	6	7	6	3	0	4	2	0	0	15.0%
150,000	8	8	8	8	8	1	3	1	1	1	0	0	0	0	0	0.0%

TOXICITY TEST

Lab ID: 48068

Test Temperature (oC): 25 ± 1

Photo Period: 16 hours light
8 hours dark

Outfall Name: product

Begin Date: 3/7/2011

End Date: 3/9/2011

Test End Time: 17:00

Effluent
Con.
ppm

Avg%
Surv.

[illegible]

BIO-AQUATIC TESTING, INC.

Effluent Concentration	Number Of Alive					Avg% Surv.
	3/7	3/8	3/9	3/10	3/11	
60,000	A	8	7	5	2	20.0%
	B	8	8	6	3	
	C	8	7	5	2	
	D	8	7	2	1	
	E	8	8	7	2	
75,000	A	8	7	5	2	12.5%
	B	8	8	5	2	
	C	8	4	0	0	
	D	8	7	2	1	
	E	8	7	3	3	
85,000	A	8	5	5	2	12.5%
	B	8	7	2	1	
	C	8	5	2	1	
	D	8	5	0	0	
	E	8	5	2	1	
100,000	A	8	5	2	2	5.0%
	B	8	6	2	0	
	C	8	3	0	0	
	D	8	8	1	1	
	E	8	6	2	2	

BIO-AQUATIC TESTING, INC.

TOXICITY TEST

96 Hr Acute8 *Pimephales promelas*

Client: Anodamine

Lab ID: 48068

Permit Number:

Test Temperature (oC): 25 ± 1

Outfall Name: product

Sample Type:

Photo Period: 16 Hours Light
8 Hours Dark

Receiving Water Name:

Test Start Time: 17:00

Test End Time: 08:10

Begin Date: 3/7/2011

End Date: 3/11/2011

SURVIVAL

Effluent Concentration	Number Of Alive					Avg% Surv.
	3/7	3/8	3/9	3/10	3/11	
Synthetic Control	A	8	8	8	8	100.0%
	B	8	8	8	8	
	C	8	8	8	8	
	D	8	8	8	8	
	E	8	8	8	8	
150,000	A	8	1	0	0	0.0%
	B	8	2	0	0	
	C	8	0	0	0	
	D	8	1	0	0	
	E	8	0	0	0	
200,000	A	8	0	0	0	0.0%
	B	8	0	0	0	
	C	8	0	0	0	
	D	8	0	0	0	
	E	8	0	0	0	

APPENDIX A

STATISTICS SUMMARY

Both the lethal and sub-lethal endpoints were statistically calculated according to their respective EPA guidelines. The Chronic Freshwater organisms were calculated according to EPA-821-R-02-013, October 2002 Fourth Edition. The Chronic Marine and Estuarine organisms were calculated according to EPA-821-R-02-014, October 2002 Third Edition. The Acute Freshwater and Marine organisms were calculated according to EPA-821-R-02-012, October 2002 Fifth Edition. Listed below are the basic principles of these guidelines. If you would like a copy of the raw statistical calculations for your test then please contact us.

The chronic and acute *Pimephales promelas* and *Menidia beryllina* survival data is analyzed using Shipiro Wilks Test and Bartlett's Test. If the data passes both tests then the data is run through ANOVA and Dunnetts (parametric). If the data fails Shipiro Wilks Test or Bartlett's Test then Steels Many One Test (non-parametric) is used. The chronic *Pimephales promelas* and *Menidia beryllina* growth data is analyzed using Shipiro Wilks Test and Bartlett's Test. If the data passes one of these tests then the data is run through ANOVA and Dunnetts. If the data fails Shipiro Wilks Test and Bartlett's Test then Steels Many One Test is used.

The chronic *Mysidopsis bahia* survival data is analyzed using Chi-square test and Bartlett's Test. If the data passes both tests then the data is run through ANOVA and Dunnetts. If the data fails Chi-square test or Bartlett's Test then Steels Many One Test is used. *Mysidopsis bahia* growth data is analyzed using Chi-square test and Bartlett's Test. If the data passes one of these tests then the data is run through ANOVA and Dunnetts. If the data fails Chi-square test and Bartlett's Test then Steels Many One Test is used.

The acute *Mysidopsis bahia* survival data is analyzed using Shipiro Wilks Test and Bartlett's Test. If the data passes both tests then the data is run through ANOVA and Dunnetts. If the data fails Shipiro Wilks Test or Bartlett's Test then Steels Many One Test is used.

The chronic *Ceriodaphnia dubia* survival data are analyzed using the Fisher's Exact Test. The chronic *Ceriodaphnia dubia* reproduction and are analyzed using the Chi-square test and Bartlett Test. If the data passes one of these tests then the data is run through ANOVA and Dunnetts. If the data fails Chi-square test and Bartlett's Test then Steels Many One Test is used.

The acute *Daphnia pulex* and *Ceriodaphnia dubia* survival data is analyzed using Shipiro Wilks Test and Bartlett's Test. If the data passes both tests then the data is run through ANOVA and Dunnetts. If the data fails Shipiro Wilks Test or Bartlett's Test then Steels Many One Test is used.

BIO-AQUATIC TESTING, INC.

pH, Dissolved Oxygen

48 Hr Acute

Daphnia pulex

Client: Anodamine

Lab ID: 48068

Facility:

Dilution Water(s):

Outfall: product

Test Begin Date: March 7, 2011

NR indicates that the test is non-renewal.

ANALYST	DATE	TIME	SX#	Concentration								
				UNIT	Synthetic	150,000	200,000					
TS	3/7	Start		pH	8.0	7.6	7.5	7.3	7.2	7.2	7.1	7.0
		DO (mg/L)		8.5	8.7	8.9	8.9	9.0	9.0	9.1	9.1	
	3/8	24 Hr		pH								
		DO (mg/L)										
		25 ± 1		pH								
		DO (mg/L)										
	3/9	Renew		pH								
		DO (mg/L)										
		48 Hr		pH	7.8	7.8	7.8	7.6	7.6	7.5	7.4	7.3
		DO (mg/L)		9.0	9.1	9.1	9.1	9.1	9.0	9.0	8.9	
	3/10	Renew		pH								
		DO (mg/L)										
		72 Hr		pH								
		DO (mg/L)										
	3/11	25 ± 1		pH								
		DO (mg/L)										
		Renew		pH								
		DO (mg/L)										
	3/12	96 Hr		pH								
		DO (mg/L)										
		25 ± 1		pH								
		DO (mg/L)										
	3/13	Renew		pH								
		DO (mg/L)										
		120 Hr		pH								
		DO (mg/L)										
	3/14	25 ± 1		pH								
		DO (mg/L)										
		Renew		pH								
		DO (mg/L)										
	3/14	144 Hr		pH								
		DO (mg/L)										
	3/14	168 Hr		pH								
		DO (mg/L)										

BIO-AQUATIC TESTING, INC.

pH, Dissolved Oxygen

96 Hr Acute

Pimephales promelas

Client: Anodamine

Lab Number: 48068

Facility:

Dilution Water(s):

Outfall: product

Test Begin Date: March 7, 2011

NR indicates that the test is non-renewal.

ANALYST	DATE	TIME	SX#	UNIT	Concentration							
					Synthetic	150,000	200,000					
TS	3/7	Start		pH	8.0	7.6	7.5	7.3	7.2	7.2	7.1	7.0
		25 ± 1		DO (mg/L)	8.5	8.7	8.9	8.9	9.0	9.0	9.1	9.1
		24 Hr		pH								
	3/8	25 ± 1		DO (mg/L)								
		Renew		pH								
				DO (mg/L)								
CM	3/9	48 Hr		pH	7.7	7.6	7.6	7.4	7.4	7.1	7.0	6.8
		25 ± 1		DO (mg/L)	8.9	9.0	9.0	8.6	8.6	8.1	8.0	7.8
		Renew		pH								
	3/10			DO (mg/L)								
		72 Hr		pH								
		25 ± 1		DO (mg/L)								
DB	3/11	Renew		pH								
				DO (mg/L)								
		96 Hr		pH	7.4	7.4	7.4	7.4	7.3	7.3	7.2	7.2
	3/12	25 ± 1		DO (mg/L)	8.1	8.1	8.1	8.1	7.8	7.5	7.4	7.3
		Renew		pH								
				DO (mg/L)								
	3/13	120 Hr		pH								
		25 ± 1		DO (mg/L)								
		Renew		pH								
	3/14			DO (mg/L)								
		144 Hr		pH								
		25 ± 1		DO (mg/L)								
	3/14	Renew		pH								
				DO (mg/L)								
		168 Hr		pH								
		25 ± 1		DO (mg/L)								

APPENDIX C

LITERATURE REFERENCES

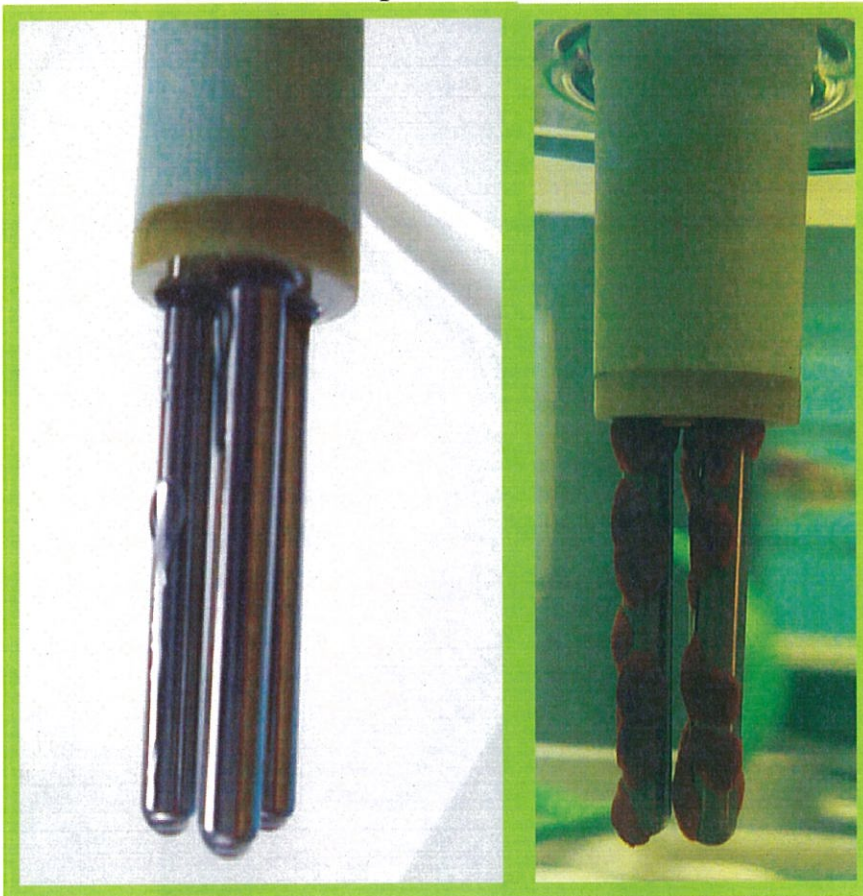
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Anodamine

Overview

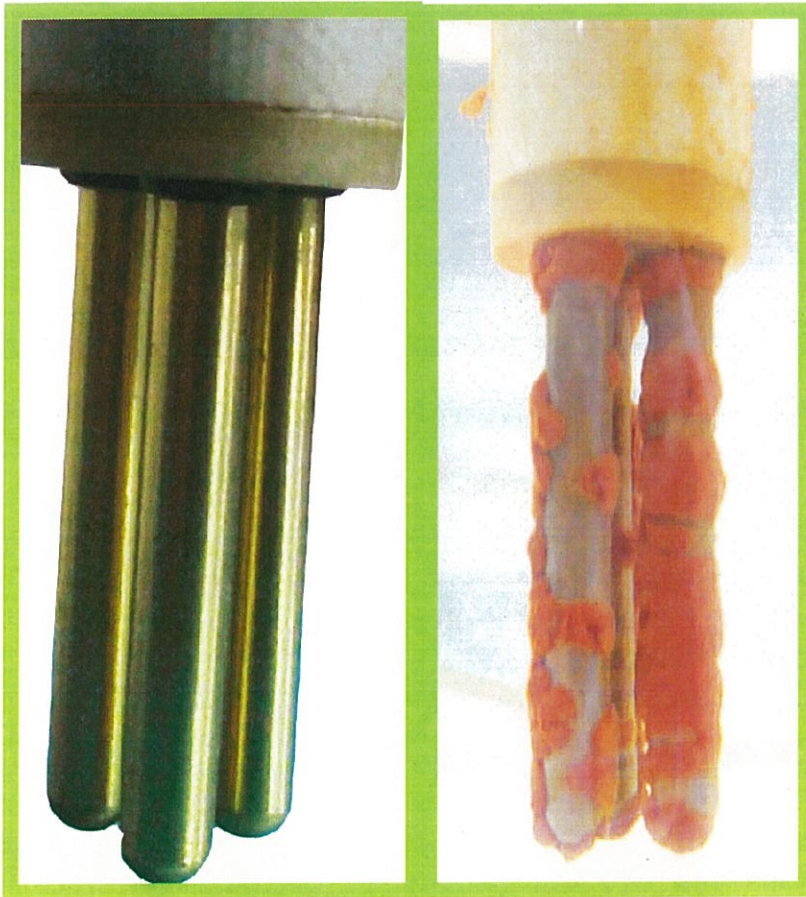
Periodically there are claims by vendors that seem too good to be true. Generally it turns out not to be true. However Anodamine (a type of filming amine that blocks the anodic surface from corrosion) was introduced to the US power market 3 years and appears to be living up to the claims.

Not your typical chemical vendor- The non hazardous product was invented by the president of the Anodamine company (formed 27 years ago) and is produced by this privately held company in Texas (www.anodamine.com). It is a filming amine that applies a hydrophobic film on the metal surface that resists corrosion. It typically requires 1PPM feed rate after the surface is initially passivated. Heat generates the film on the metal surface. The product can penetrate existing deposits and protect the metal under the deposit. It works on steel and cooper.



Anodamine- steel

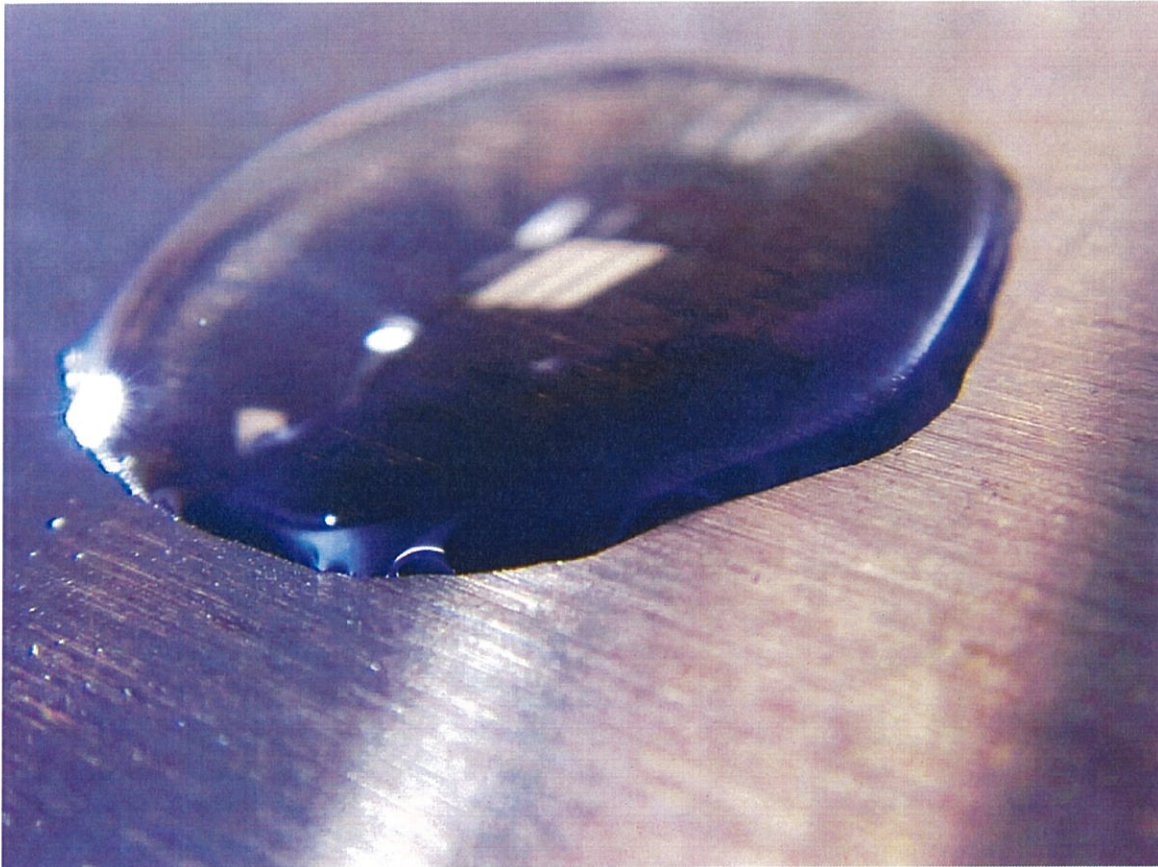
steel without



Anodamine – copper

Copper – without

It was first introduced as a product fed prior to shutdown. The system which can be laid up wet or dry without further treatment resists surface rust and pitting that normally occurs. The wet metal surfaces look like a car that has been waxed. Recent experience presentations in the power industry confirm this appearance during an outage.



Wet layup of boilers can be of value for quick turnaround for service. The film does not deteriorate during outages.

Typically organic formulations including other filming amines decompose in high pressure boilers forming organic acids. They can also form waxy deposits. Anodamine appears to be unique. This product is thermally stable at high temperatures. It is currently being tested on a supercritical unit. It does not have the negative effects that are typical of other organic treatments.

Within the last year, US utilities have tested this product for continuous treatment. Since the metal surface has a film, oxygen does not have the normal effect on corrosion. Influx of oxygen during shutdown or cycling does not have the negative effects typically seen. Hydrazine can be eliminated from mixed alloy systems without copper corrosion.

Anodamine also protects against FAC and slows stress corrosion cracking.

Objectives

The objectives of our chemical program should include the following:

- **To protect & Ensure Safety Of All Staff & Site Personnel.**
- **Avoid Exposure of People & Environment to Toxic Chemistries.**
- **Prevention Of Corrosion In All Steam / Water Sections.**
- **Preventing Scale and/or Deposits – Efficiency Of Heat Transfer.**
- **Eliminating Boiler Cleaning.**
- **Protecting against Operational Peculiarities**
- **Ease Of Application.**
- **Economics Of Treatment.**

This product addresses all of these concerns.

This test could be beneficial to future use in the auxiliary boiler, and also potential reduction of FAC in heater drains in the supercritical units. I have not seen any studies or claims on the effects on duplex oxides formed in the superheater.

People in the power industry are proceeding cautiously as we should. This may seem like a sales pitch but many utility chemists feel we may be on the edge of a major breakthrough in power plant chemistry.

We will actually be reducing our safety and environmental risk during the review process of this product.

Technical Support & Service

We will monitor our chemistry extensively before and during the conversion to anodamine on U1-U3. The Anodamine Company has offered to do many of these tests and trending at no additional cost. They will also assist with the conversion of the hydrazine system to anodamine feed. The results should demonstrate that we are seeing a reduction in corrosion and visual inspections when we shut down should also demonstrate an improvement.

Recommendations

After getting environmental approval and review, I would like to start testing this product at various locations. If it lives up to our expectations we could look for applications system wide. I do not expect any negative effects since this product is being used at other utilities with no negative consequences as verified in discussions with their system chemists and reports.

Since U1-U3 may be mothballed in or around July we could demonstrate use in mixed alloy high pressure systems with reduced risk. We have several of these types of units system wide. Some are using hydrazine while others are using substitutes. Many of these units are showing high levels of copper corrosion.

Negative aspects-

- We will have to use a different pump instead of the hydrazine pump.
- The product is fed neat with a nitrogen cylinder providing a blanket on the chemical tote.
- We will have to train on the new spectrophotometric test used for control
- We will need to rewrite and train on some new procedures and specifications.